

**Claims:**

1. An apparatus for sensing deflection in a structural element, comprising:
  - a structural element;
  - a waveguide affixed to the structural element in a fixed relative position;
  - a transmitter and receiving apparatus in communication with the waveguide for sensing a transmitted signal therethrough; and
  - a sensing apparatus for correlating sensed modulated signal with a deflection of the structural element.
2. The apparatus of claim 1, wherein the structural element is a beam, a cylindrical shaft, and a torsion bar.
3. The apparatus of claim 1, wherein the transmitted signal comprises visible and non-visible frequency waves.
4. The apparatus of claim 1, wherein the transmitted signal comprises photonic waves and electromagnetic radiation waves.
5. The apparatus of claim 1, wherein the waveguide comprises fiber optic cable helically wrapped at 45 ° around the structural element.

6. The apparatus of claim 1, wherein the waveguide comprises multiple helical fiber optic cables helically wrapped at 45 ° around the structural element.
7. The apparatus of claim 1, wherein the waveguide comprises a fiber optic sleeve coaxially wrapped about the structural element.
8. The apparatus of claim 1, wherein the waveguide is driven by the transmitter comprising an electromagnetic radiation transmitter.
9. The apparatus of claim 1, wherein the transmitter comprises an LED source.
10. The transmitter of claim 9, wherein the LED source comprises a current source and an analog oscillator and emits the transmitted signal through a first end of the waveguide.
11. The apparatus of claim 1, wherein the waveguide is driven by a laser light source that emits the transmitted signal through the first end of the waveguide.
12. The apparatus of claim 1, wherein the receiver apparatus collects the modulated signal exiting through a second end of the waveguide.

13. The apparatus of claim 12, wherein the receiver apparatus conditions and analyzes the modulated signal with a signal processor.
14. The apparatus of claim 1, wherein a deformation of the waveguide comprises applying a stress to the structural element.
15. The apparatus of claim 14, wherein the stress comprises a torque.
16. The apparatus of claim 15, wherein the deformation of the waveguide results in altering an angle of refraction of the waveguide.
17. The apparatus of claim 1, wherein a modulation of the transmitted signal is measured by a chromatic dispersion, lost modes, and spectral spreading.
19. The apparatus of claim 1, wherein the modulation of the transmitted signal is measured by an attenuation of the transmitted signal as a function of a force applied to an outside surface of the waveguide.
20. The apparatus of claim 1, wherein the waveguide is affixed to the structural element in relative position by bonding techniques, using mechanical fasteners, component embedding or molding, and using standoffs.

21. The apparatus of claim 1, wherein the waveguide is melted onto the structural element by heating the stress bearing member.

22. A photonic torque sensor apparatus that senses torque applied to a stress bearing element in a vehicle, comprising:

a waveguide affixed to the stress bearing element wherein a deformation of the waveguide measures the torque applied to the stress bearing element.

23. The apparatus of claim 22, wherein the waveguide comprises an optical waveguide.

24. The apparatus of claim 22, wherein the stress bearing element is a beam, a cylindrical shaft, and a torsion bar.

25. The apparatus of claim 22, wherein the waveguide comprises fiber optic cable helically wrapped at 45 ° around the stress bearing element.

26. The apparatus of claim 22, wherein the waveguide comprises multiple helical fiber optic cables helically wrapped at 45 ° around the stress bearing element.

27. The apparatus of claim 22, wherein the waveguide comprises a fiber optic sleeve coaxially wrapped about the stress bearing element.

28. The apparatus of claim 22, wherein the waveguide is driven by an LED source comprising a current source and an analog oscillator.

29. The apparatus of claim 28, wherein the LED source emits a photon carrier wave through a first end of the optical waveguide.

30. The apparatus of claim 22, wherein the waveguide is driven by a laser light source that emits the photon carrier wave through the first end of the waveguide.

31. The apparatus of claim 22, wherein a receiver collects the modulated transmission signal exiting through the second end of the waveguide.

32. The apparatus of claim 22, wherein the receiver conditions and analyzes the modulated transmission signal with a signal processor.

33. The apparatus of claim 22, wherein the deformation of the waveguide comprises applying a stress to the stress bearing element.

34. The apparatus of claim 22, wherein the stress comprises a torque.

35. The apparatus of claim 22, wherein the deformation of the waveguide results in altering an angle of refraction of the waveguide.

36. The apparatus of claim 22, wherein the modulation of the transmission signal is measured by a chromatic dispersion, a lost modes, and a spectral spreading.

37. The apparatus of claim 22, wherein the modulation of the transmission signal is measured by an attenuation of the propagating transmission signal as a function of a force applied to an outside surface of the waveguide.

38. The apparatus of claim 22, wherein the waveguide is affixed to the structural element in relative position by bonding techniques, using mechanical fasteners, component embedding, component molding, and using standoffs.

39. The apparatus of claim 22, wherein the waveguide is melted onto the stress bearing element by heating the stress bearing member.

40. The apparatus of claim 22, wherein a vehicle is a wheeled, self-powered means for transportation.

41. Method for sensing deflection of a structural element comprising:
- fixing a waveguide in relative position to a structural element;
  - transmitting a signal through the waveguide; and
  - correlating differences in the signal to a deflection of the structural member.
42. The method of claim 41, wherein the structural element is a beam, a cylindrical shaft, and a torsion bar.
43. The method of claim 41, wherein the signal comprises visible and non-visible frequency waves.
44. The method of claim 41, wherein the signal comprises photonic waves and electromagnetic radiation waves.
45. The method of claim 41, wherein the waveguide comprises fiber optic cable helically wrapped at 45 ° around the structural element.
46. The method of claim 41, wherein the waveguide comprises multiple helical fiber optic cables helically wrapped at 45 ° around the structural element.
47. The method of claim 41, wherein the waveguide comprises a fiber optic sleeve coaxially wrapped about the structural element.

48. The method of claim 41, wherein the waveguide is driven by the transmitter comprising an electromagnetic radiation transmitter.

49. The method of claim 41, wherein the transmitter comprises an LED source.

50. The transmitter of claim 49, wherein the LED source comprises a current source and an analog oscillator and emits the signal through a first end of the waveguide.

51. The method of claim 41, wherein the waveguide is driven by a laser light source that emits the signal through the first end of the waveguide.

52. The method of claim 41, wherein the receiver apparatus collects the modulated signal exiting through a second end of the waveguide.

53. The method of claim 41, wherein the receiver apparatus conditions and analyzes the modulated signal with a signal processor.

54. The method of claim 41, wherein a deformation of the waveguide comprises applying a stress to the structural element.

55. The method of claim 41, wherein the stress comprises a torque.



56. The method of claim 55, wherein the deformation of the waveguide results in altering an angle of refraction of the waveguide.

57. The method of claim 41, wherein a modulation of the signal is measured by a chromatic dispersion, lost modes, and spectral spreading.

58. The method of claim 41, wherein the modulation of the signal is measured by an attenuation of the transmitted signal as a function of a force applied to an outside surface of the waveguide.

59. The method of claim 41, wherein the waveguide is affixed to the structural element in relative position by bonding techniques, using mechanical fasteners, component embedding or molding, and using standoffs.

60. The method of claim 41, wherein the waveguide is melted onto the structural element by heating the stress bearing member.

61. Method for manufacturing a sense element immune to noise in a vehicle, the method comprising:

forming a waveguide; and

coupling a waveguide to stress bearing element.

62. The method of claim 61, wherein the stress bearing element is a beam, a cylindrical shaft, and a torsion bar.

63. The method of claim 61, wherein the waveguide comprises fiber optic cable helically wrapped at 45 ° around the stress bearing element.

64. The method of claim 61, wherein the waveguide comprises multiple helical fiber optic cables helically wrapped at 45° wrapped around the stress bearing element.

65. The method of claim 61, wherein the optical waveguide comprises a fiber optic sleeve coaxially wrapped around the stress bearing element.

66. The method of claim 61, wherein the waveguide is affixed to the structural element in relative position by bonding techniques, using mechanical fasteners, component embedding, component molding, and using standoffs.

67. The method of claim 61, wherein the waveguide is melted onto the stress bearing element by heating the stress bearing member.

68. The method of claim 61, wherein a vehicle is a wheeled, self-powered means for transportation.